



2024

Section: Obstetrics and Gynecology

Comparison Between Transcerebellar Diameter and Biparietal Diameter and Femur Length for Gestational Age Measurement Accuracy in Third Trimester

Abd Almenem zakaria

Department of Obstetrics and Gynecology, Faculty of Medicine for boys, Al-Azhar University, Cairo, Egypt.

Ahmed Mohamed Saeed

Department of Obstetrics and Gynecology, Faculty of Medicine for boys, Al-Azhar University, Cairo, Egypt.

Mohammed Hassan Mohammed

*Department of Obstetrics and Gynecology, Faculty of Medicine for boys, Al-Azhar University, Cairo, Egypt.,
drmhm1991@gmail.com*

Follow this and additional works at: <https://aimj.researchcommons.org/journal>



Part of the [Medical Sciences Commons](#), [Obstetrics and Gynecology Commons](#), and the [Surgery Commons](#)

How to Cite This Article

zakaria, Abd Almenem; Saeed, Ahmed Mohamed; and Mohammed, Mohammed Hassan (2024) "Comparison Between Transcerebellar Diameter and Biparietal Diameter and Femur Length for Gestational Age Measurement Accuracy in Third Trimester," *Al-Azhar International Medical Journal*: Vol. 5: Iss. 2, Article 22.

DOI: <https://doi.org/10.58675/2682-339X.2290>

This Original Article is brought to you for free and open access by Al-Azhar International Medical Journal. It has been accepted for inclusion in Al-Azhar International Medical Journal by an authorized editor of Al-Azhar International Medical Journal. For more information, please contact dryasserhelmy@gmail.com.

Comparison Between Transcerebellar Diameter and Biparietal Diameter and Femur Length for Gestational Age Measurement Accuracy in Third Trimester

Abd Almenem Mohammed Zakaria, Ahmed Mohamed Saeed,
Mohammed Hassan Mohammed*

Department of Obstetrics and Gynecology, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt

Abstract

Less of the physiologic diversity of late gestation was evident in transcerebellar diameter (TCD) compared with several other biometric measures. Menstrual history, clinical examination, and ultrasound are all used to estimate the gestational age (GA) of a fetus. In the absence of known risk factors, diagnostic ultrasonography is routinely used to monitor fetal development and confirm the presence of clinical complications. Our study aimed at comparison of the current last menstrual period (LMP), femur length (FL), as well as biparietal diameter (BPD) with TCD measurement for estimating GA in the third trimester. Our study was an observational trial carried out on a total of 100 pregnant women during the months of September 2021 and March 2022 at the Department of Obstetrics and Gynecology at Al Hussein Hospital, which is affiliated with Al-Azhar University in Cairo (inpatient and outpatient). According to our results, there was a statistically significant alteration amongst the studied groups as regard (Agreement between the gyrus angle estimated by TCD, FL and BPD compared with gyrus angle estimated by LMP), (correlation of TCD, FL, BPD with GA estimated by LMP) and (correlation of TCD with FL and gyrus angle estimated by LMP among the females in third trimester). Regarding our results, we can concluded that TCD calculates third-trimester GA more accurately than BPD. Third trimester TCD and FL help determine fetus GA.

Keywords: Biparietal diameter, Femur length, Gestational age measurement, Third trimester, Transcerebellar diameter

1. Introduction

Women must estimate their expected delivery date to know when their baby is due. A series of tests will be performed in order to arrive at an accurate estimate of when the baby will be born. The date of the 1st day of the last menstrual cycle, clinical examination, and ultrasound are some of the procedures that can be used to calculate the gestational age.¹

The biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL) are the four fundamental measurements that can be obtained by following the standard standards established by the American Institute of ultrasound in Medicine.²

In the third trimester, a number of ultrasound characteristics, including FL, are used for predicting gestational age (GA) of the baby, however, this method has a margin of error that ranges from two to three weeks in comparison to the actual gestational age.³

Because of the wide range of normal variation in fetal skull size and shape, the BPD can be off by as much as three or four weeks from the actual gestational age.⁴

In the third trimester, when the head is excessively molded, BPD, as well as HC, become unreliable, but transcerebellar diameter (TCD) becomes a reliable marker for gestation because the cerebellum is protected inside the posterior fossa by dense pterous as well as occipital bones.⁵

Accepted 8 September 2023.
Available online 6 May 2024

* Corresponding author at: Department of Obstetrics and Gynecology, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt.
E-mail address: drmh1991@gmail.com (M.H. Mohammed).

<https://doi.org/10.58675/2682-339X.2290>

2682-339X/© 2024 The author. Published by Al-Azhar University, Faculty of Medicine. This is an open access article under the CC BY-SA 4.0 license (<https://creativecommons.org/licenses/by-sa/4.0/>).

In the presence of fetal head shape variation (for example dolichocephaly or brachycephaly), TCD provides a more accurate estimate of gestational age.⁶

TCD is used when calculating BPD is too challenging, unattainable, or inappropriate due to the head's obvious shape.⁷

The research aimed to determine how well TCD measurements compared with current last menstrual period (LMP), FL, and BPD for estimating GA in the third trimester.

2. Patients and methods

This observational trial was performed on one hundred pregnant women at the Department of Obstetrics and Gynecology at Al Hussein Hospital, Al-Azhar university in Cairo (inpatient and outpatient) between September 2021 in addition to March 2022. All of the individuals were in the third trimester of their pregnancies, as well as the TCD, the BPD, as well as the FL were measured to determine their gestational ages. One hundred pregnant ladies who were between 28 and 40 weeks along in their pregnancies participated in this research study. The ethical committee at Al Azhar University assessed the study protocol and the patients' informed consent forms before giving its stamp of approval.

The inclusion criteria were: women of child-bearing age carrying a singleton pregnancy without complications between the ages of 31 and 36 weeks of pregnancy, with the start of the pregnancy being considered the 1st day of the woman's most recent menstrual cycle.

The Exclusion criteria were: women who were unsure of their due dates, women who had experienced intrauterine fetal mortality, women who had anomalous fetuses, women who had experienced many pregnancies, and women who suffered from medical conditions such as hypertension or diabetes were not allowed to participate. Sampling Method: Convenient sample of pregnant women in Obstetrics and Gynecology clinic of AL Azhar University Hospitals meeting the inclusion criteria were enrolled in the study till the sample size was reached.

2.1. Sample size

This study base on study carried out by El-Sayed and colleagues was used to calculate the sample size by considering the following assumptions:—95% two-sided confidence level, with a power of 80%, and α error of 5%. The final maximum sample size taken from output was 94. Thus, the sample size was increased to 100 patients to assume any drop out cases during follow-up.⁸

Sample Size For Comparing Two Means

| Input Data | | | |
|--|---------|---------|-------------|
| Confidence Interval (2-sided) | 95% | | |
| Power | 80% | | |
| Ratio of sample size (Group 2/Group 1) | 1 | | |
| | Group 1 | Group 2 | Difference* |
| Mean | 31.84 | 31.33 | 0.51 |
| Standard deviation | 0.96 | 0.79 | |
| Variance | 0.9216 | 0.6241 | |
| Sample size of Group 1 | 47 | | |
| Sample size of Group 2 | 47 | | |
| Total sample size | 94 | | |

*Difference between the means

Results from OpenEpi, Version 3, open source calculator--SSMean
Print from the browser with ctrl-P
or select text to copy and paste to other programs.

2.1.1. Ethics consideration

The research protocol's conduct, evaluation, as well as documentation procedures ensured that the study followed good clinical practice in addition to the ethical principles in the most recent revision of the declaration of Helsinki. This was accomplished by ensuring that the investigation was documented properly. Following receipt of permission from Al Azhar University's Ethical committee, the research was carried out.

Women who were pregnant at the time of enrollment in the trial gave their verbal consent to participate in the trial.

2.2. Study procedure

Persons incorporated within trial were subjected to the following: Informed consent, Detailed History, Physical examination (general examination and Abdominal examination) in addition to Ultrasound to evaluate the following: fetal viability, FL, BPD, also TCD.

The ultrasound was performed in the obstetrics and gynecology clinic at Al Husin Hospital to determine the GA of the fetus by measuring the fetal TCD, BPD, and femur length. Trans-abdominal ultrasounds were performed on all patients, with the head of the bed elevated 30° and a little pillow placed under the right loin to ensure comfort for each individual.

TCD better measure up to 26 gestational weeks.

2.2.1. Ultrasound device

Phillips ultrasound machine, Sony corporation 1-7-1 konan minato-ku.

2.3. Statistical methods

IBM SPSS statistics (Statistical Package for the Social Sciences) version 18.0, IBM Corp., Chicago, USA, 2009, was used for data coding and entry. Frequencies and percentages were used as descriptive statistics for categorical variables. If the data were regularly distributed, the quantitative variables were shown as means \pm standard deviation. Using the LMP as a proxy for gestational age, correlations among TCD, BPD, as well as FL were determined. Agreement between parameters is calculated. Pearson's correlation between gyrus angle estimated by different parameters and GA calculated by LMP is performed. In addition, multiple linear regression was analyzed. *P* values below 0.05 were considered as statistically significant.

3. Results

Table 1.

Table 1. Socio-demographic data amongst the studied group (*n* = 100).

| Socio-demographic data | (<i>N</i> = 100) [<i>n</i> (%)] |
|-------------------------|-----------------------------------|
| Age (y) | |
| Mean (\pm SD) | 29.39 \pm 5.07 |
| Range (minimum–maximum) | 19–40 |
| Residence | |
| Urban | 55 (55) |
| Rural | 45 (45) |

This table showed that where the mean age of the pregnant female's variable was from 19 to 40 years with a mean of (29.39 \pm 5.07) years. Additionally, most of the females lived in urban areas (55%) (Table 2).

Table 2. Obstetric characteristics of the studied group (*n* = 100).

| Obstetric characteristics | (<i>N</i> = 100) [<i>n</i> (%)] |
|---------------------------|-----------------------------------|
| Parity | |
| Primi | 24 (24) |
| Multi | 76 (76) |
| GA (weeks) | |
| 28–35 | 28 (28) |
| 36–40 | 72 (72) |
| Obstetric characteristics | Mean \pm SD |
| Blood pressure (mmHg) | |
| Systolic | 113.9 \pm 9.42 |
| Diastolic | 75.35 \pm 7.92 |
| TCD (mm) (Mean \pm SD) | 41.57 \pm 8.11 |
| BPD (mm) (Mean \pm SD) | 79.89 \pm 11.19 |
| FL (mm) (Mean \pm SD) | 63.79 \pm 28.04 |

Most of the participants were multiparous (76%), their mean systolic blood pressure was (113.9 \pm 9.42) mmHg and their mean diastolic blood pressure was (75.35 \pm 7.92) mmHg. Regarding the distribution of the females according to their week of gestation, most of the females (72%) were in their 36th–40th week of pregnancy, and (28%) were in their 28th–35th week of gestation. As for the different parameters for gyrus angle estimation that were calculated, Table 3 shows that the mean trans cerebellar diameter was (41.57 \pm 8.11), the BPD was (79.89 \pm 11.19) and the FL was (63.79 \pm 28.04).

Table 3. Agreement amongst the gestational age estimated by trans-cerebellar diameter, femur length, and biparietal diameter equated to gyrus angle estimated by last menstrual period among the studied group (*n* = 100).

| Parameters | Cronbach's Alpha | Intraclass correlation | Confidence interval | <i>P</i> value |
|------------|------------------|------------------------|---------------------|----------------|
| TCD | 0.994 | 0.987 | 0.981–0.991 | <0.001 |
| BPD | 0.941 | 0.889 | 0.839–0.924 | <0.001 |
| FL | 0.961 | 0.925 | 0.890–0.949 | <0.001 |

Paired *t*-test, *statistically significant values will be in bold.

This table showed that the highest intraclass correlation was found with the TCD (0.987) which indicated a high level of reliability with high statistical significance of $P \leq 0.001$. Nevertheless, all parameters were significantly reliable (Table 4).

Table 4. Correlation of transcerebellar diameter, femur length, biparietal diameter with gestational age estimated by last menstrual period among the studied group ($n = 100$).

| Parameters | r* | P value** |
|------------|-------|-----------|
| TCD | 0.989 | <0.001 |
| BPD | 0.891 | <0.001 |
| FL | 0.932 | <0.001 |

Pearson's correlation.

* Statistically significant values will be in bold.

This table showed that the highest an association was found to exist among the TCD and the LMP ($r = 0.989$), however, all correlations were strong and positive and were statistically significant (Table 5).

Table 5. Correlation of transcerebellar diameter with femur length and gyrus angle estimated by last menstrual period among the females in third trimester ($n = 72$).

| Parameters | TCD | FL | LMP |
|---------------------|--------|--------|--------|
| TCD | | | |
| Pearson Correlation | 1 | 0.780* | 0.980* |
| P value | | <0.001 | <0.001 |
| FL | | | |
| Pearson Correlation | 0.780* | 1 | 0.793* |
| P value | <0.001 | | <0.001 |

* Statistically significant values.

This table showed that the highest connection was detected among the TCD and the LMP ($r = 0.980$), while the least correlation was found between the FL and the TCD ($r = 0.780$). However, all correlations were strong and positive and were statistically significant (Table 6).

Table 6. Accuracy rate of the transcerebellar diameter (within two weeks) in comparison with the femur length during the third trimester ($n = 72$).

| Parameters | Accurate assessment | Percentage |
|------------|---------------------|------------|
| TCD | 71 | 98.61% |
| FL | 52 | 72.22% |

This table showed that TCD is shown to be more accurate than FL during the third trimester.

4. Discussion

There was a three-week discrepancy or more among the gyrus angle estimates from the first

trimester ultrasound as well as the ultrasound performed late in the third trimester. Recent research suggests that ultrasound can be used to more accurately estimate GA in the third trimester of pregnancy than was previously thought.⁹

The ultrasound community generally agreed that TCD was a reliable parameter for estimating the duration of gestation and that it was consistently ahead of the curve in predicting gyrus angle in both singletons along with twin pregnancies, as well as at the extremes of fetal growth.¹⁰

TCD and GA were studied to confirm their association and to determine whether or not TCD can predict gyrus angle. A total of 221 infants with diagnosed gyrus angle had their TCD evaluated. He discovered a robust relationship among TCD and gyrus angle and projected its duration to be around ± 2.33 weeks. The TCD was very reliably measured.¹¹

Fifty pregnant women, aged from 20 to 40, who had been in for a routine ultrasound were surveyed. Their pregnancies ranged from 14 to 40 weeks. The ultrasound TCD measurement was utilized to calculate the gestational age. TCD was found to have a statistically significant connection with gyrus angle, suggesting that TCD is a reliable marker for the assessment of GA.¹²

We also investigated the data at 31 and 36 weeks of gestation because another study¹⁸ reported a little variation in the growth curve of the fetal cerebellum, indicating numerous situations that might cause difficulty in measuring the transcerebellar diameter in late gestations.

During the second and third trimesters of a singleton pregnancy, an experiment was conducted in 2014 to investigate the precision of the fetal TCD nomogram measurement in determining the GA of the fetus. Even in the third trimester, the TCD measurement was found to have an acceptable level of accuracy. When determining the gestational age of a typical singleton pregnancy, biometric ultrasound data such as the TCD should be considered.¹³

In 2000, a retrospective, cross-sectional investigation of 360 normally growing fetuses among 17 and 34 weeks and 73 growth-restricted fetuses among 24–34 weeks indicated that IUGR generally spares TCD assessment. Even with significant growth restriction, TCD was barely altered.¹⁴

An additional investigation was performed in 2014 with the objective of determining the precision of measuring the fetal transverse cerebellar diameter in growth-restricted fetuses in order to arrive at an estimate of the GA of the fetus. One hundred pregnant women who fulfilled the criteria for participation were surveyed for this study during the third

trimester, of them, 50 had babies with normal fetal growth and 50 carried babies with growth restriction. The findings demonstrated a lack of statistical significance among the mean TCD of normally developing fetuses and that of a fetus with growth restriction. Since there was no significant variance among normal and growth limited fetal TCD readings, they concluded that TCD values appear to correspond well with the GA in both groups.

Fetuses whose growth is restricted may have their GA accurately estimated by measuring their TCD.¹⁴

It was found through research that measuring the fetal TCD was a reliable as well as precise way of estimating the GA of a fetus, even at the extremes of its growth. When GA is unknown or IUGR is suspected, the TCD is very helpful, according to the majority of researches.¹⁰

Although this study contained only 44 IUGR fetuses, symmetrical IUGR was not excluded, it was also discovered that only forty percent of TCD were within two standard deviations.¹⁵

When a fetus has asymmetric growth retardation but not symmetric, the TCD has been used as a predictor of GA in several studies.¹⁵

Using prenatal development indicators such as BPD, head circumference, FL, as well as estimated fetal weight, previous research demonstrated a strong link among cerebellar dimensions as well as gyrus angle that was not influenced by fetal gender.¹⁶

BPD, head circumference, belly circumference, FL, and TCD GA prediction ranges were derived from 270 normal fetuses that exists between 14 and 40 weeks of gestation in 1991 research. When compared with other ultrasonography markers, TCD was associated with the least level of underestimation bias and was able to accurately predict GA for 6 fetuses with asymmetric intrauterine growth retardation.¹⁶

In 2007, researchers discovered that gyrus angle was positively correlated with cerebellar circumference and area, and that these measurements could be helpful in diagnosing cases of unilateral cerebellar agenesis and hypoplasia. Consequently, if normograms of TCD were available for a certain population, measuring cerebellar dimensions like the TCD might be useful in diagnosing cerebellar abnormalities.¹⁷

4.1. Conclusion

When determining the GA of the baby during the third trimester of pregnancy, the TCD is a method that is more precise than the BPD. In the third trimester, the TCD also the length of the femur are employed as tools to assist in the determination of the GA.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article.

Conflicts of interest

The authors declared that there were no conflicts of interest.

References

- Mongelli M, Benzie R. Ultrasound diagnosis of fetal macrosomia: a comparison of weight prediction models using computer simulation. *Ultrasound Obstet Gynecol.* 2005;26: 500–503.
- Crino J, Finberg H, Friden F, et al. AIUM practice guideline for the performance of obstetric ultrasound examinations. *J Ultrasound Med.* 2013;32:1083–1101.
- Abd El Fattah AT, Shaban HS, Younis EAA. Comparison between trans-cerebellar diameter, Bi-parietal diameter and femur length for gestational age measurement accuracy in third trimester of pregnancy. *Egypt J Hosp Med.* 2018;73: 6463–6469.
- Zakaria AM, Mohamed AH, Eldarder AKM. Comparison between transcerebellar diameter, biparietal diameter and femur length for gestational age measurement accuracy in third trimester of pregnancy. *Egypt J Hosp Med.* 2019;74:17–22.
- Prasad VN, Dhakal V, Chhetri PK. Accuracy of transverse cerebellar diameter by ultrasonography in the evaluation gestational age of fetus. *J Coll Med Sci - Nepal.* 2017;13: 225–228.
- Delaney M, Roggensack A, No. 214-Guidelines for the management of pregnancy at 41+ 0 to 42+ 0 weeks. *J Obstet Gynaecol Can.* 2017;39:e164–e174.
- Bavini S, Mittal R, Mendiratta SL. Ultrasonographic measurement of the transcerebellar diameter for gestational age estimation in the third trimester. *J Ultrasound.* 2021;25: 281–287.
- El-Sayed YA, Mohamed ME, Abdel Salam WA, et al. Assessment of transcerebellar diameter accuracy in detection of gestational age in third trimester in cases of intrauterine growth restriction. *Egypt J Hosp Med.* 2021;82:426–432.
- Doubilet P, Benson C. Improved prediction of gestational age in the late third trimester. *J Ultrasound Med.* 1993;12:647–653.
- Chavez MR, Ananth CV, Smulian JC, et al. Fetal transcerebellar diameter measurement for prediction of gestational age at the extremes of fetal growth. *J Ultrasound Med.* 2007;26:1167–1171.
- Davies MW, Swaminathan M, Betheras FR. Measurement of the transverse cerebellar diameter in preterm neonates and its use in assessment of gestational age. *Australas Radiol.* 2001; 45:309–312.
- Goel P, Singla M, Ghai R, et al. Transverse cerebellar diameter: a marker for estimation of gestational age. *J Anat Soc India.* 2010;59:158–161.
- Ahmed MA. Accuracy of fetal transcerebellar diameter nomogram in the prediction of gestational age in singleton gestation at the second and the third trimesters of singleton pregnancy. *J Evid-Based Women's Health J Soc.* 2014;4:184–188.
- Afshan A, Nadeem S, Asim SS. Fetal transverse cerebellar diameter measurement; A useful predictor of gestational age in growth restricted fetuses. *Prof Med J.* 2014;21:888–891.

15. Hill LM, Guzick D, Rivello D, Hixson J, Peterson C. The transverse cerebellar diameter cannot be used to assess gestational age in the small for gestational age fetus. *Obstet Gynecol.* 1990;75:329–333.
16. Lee W, Barton S, Comstock CH, et al. Transverse cerebellar diameter: a useful predictor of gestational age for fetuses with asymmetric growth retardation. *Am J Obstet Gynecol.* 1991;165:1044–1050.
17. Sherer D, Sokolovski M, Dalloul M, Pezzullo J, Osho J, Abulafia O. Nomograms of the axial fetal cerebellar hemisphere circumference and area throughout gestation. *Ultrasound Obstet Gynecol.* 2007;29:32–37.
18. Chavez MR, Ananth CV, Smulian JC, Vintzileos AM. Fetal transcerebellar diameter measurement for prediction of gestational age at the extremes of fetal growth. *J Ultrasound Med.* 2007;26:1167–1171.